Dissolution of infection-induced struvite bladder stones by using a noncalculolytic diet and antibiotic therapy

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Abstract — An 8-year-old, female spayed miniature schnauzer was presented for pollakiuria and gross hematuria. Infection-induced struvite urolithiasis with concurrent bacterial urinary tract infection was diagnosed. The treatment is described, followed by a brief discussion of struvite stones and their medical management.

Résumé — Fonte des calculs de struvite causés par une infection de la vessie, par l'emploi d'une diète non calculolytique et de l'antibiothérapie. On a examiné une chienne stérilisée schnauzer nain, âgée de 8 ans, à cause de pollakiurie et d'hématurie macroscopique. On a posé un diagnostic d'urolithiase de struvite causée par une infection, avec infection bactérienne concomitante du tractus urinaire. On décrit le traitement, suivi d'une brève discussion sur les calculs de struvite et leur contrôle médical.

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An 8-year-old, 7 kg, spayed female miniature schnauzer was presented to the referring veterinarian for pollakiuria and hematuria. The dog had a history of pruritus, attributed to seasonal allergies. No changes in eating or drinking habits were reported, there was no history of vomiting or diarrhea. The current diet was a commercial dry formula (Purina Lamb and Rice; Purina, St. Louis, Missouri, USA), vaccinations were current, and the dog was not receiving any medication.

Physical examination revealed a thin hair coat, good body condition, and moderate periodontal disease. Evaluation included a urinalysis, urine culture and sensitivity testing, and abdominal radiographs.

Urine was collected by free-flow and was stored in a refrigerator for several hours prior to evaluation. On gross evaluation, the urine had a cloudy appearance and a specific gravity of 1.050. A urine dipstick test was performed and the results were a urine pH of 8, 3 g/L protein, and large numbers of red blood cells. On microscopic evaluation, numerous red and white blood cells, moderate numbers of coccoid bacteria and struvite crystals, and epithelial cells in clumps were observed. On a single lateral abdominal radiograph, multiple round to ovoid radiodense uroliths, the largest measuring 1 cm in diameter were seen (Figure 1A). No other radiographic abnormalities were identified. Urine obtained by cystocentesis was submitted for culture and revealed a heavy growth of *Staphylococcus intermedius,* susceptible to multiple antimicrobials, including cephalexin.

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These findings were consistent with a diagnosis of infection-induced struvite urolithiasis with concurrent urinary tract infection. Because of financial constraints, medical therapy, rather than surgical treatment, was initiated using cephalexin (Novo-Lexin; Novopharm, Toronto, Ontario) 250 mg, PO, q12h for 30 d. The dog's diet was changed to a low fat, mildly protein-restricted, moderately acidifying commercial canned food (Medi-Cal Weight/Control Mature Formula; Veterinary Medical Diets, Guelph, Ontario). The amount fed was based on the manufacturer's feeding guidelines. Follow-up urine culture and sensitivity testing and abdominal radiographs were planned at 30-day intervals.

The dog was clinically normal for approximately 14 d and then experienced an episode of hematuria, dysuria, lethargy, and urine dribbling. These signs resolved within 24 h. The dog was rechecked at approximately 40 d, when, clinically, it was apparently normal and the body weight was unchanged at 7 kg. On abdominal radiographs, fewer stones were observed, and the remaining stones were less radiodense (Figure 1B), with the largest stones measuring 0.5 cm in diameter. Urine obtained by cystocentesis revealed a urine pH of 6.5; although generally recommended, specific gravity was not evaluated. A urine dipstick test showed trace protein and moderate numbers of red blood cells. On microscopic evaluation, a few red and white blood cells, moderate numbers of amorphous crystals, occasional struvite crystals, and moderate numbers of coccoid bacteria were observed. Urine culture yielded no growth; therefore, bacterial contamination of the stain was suspected. Continued treatment with an antimicrobial was recommended until the next scheduled recheck (30 d). Dietary recommendations remained unchanged.

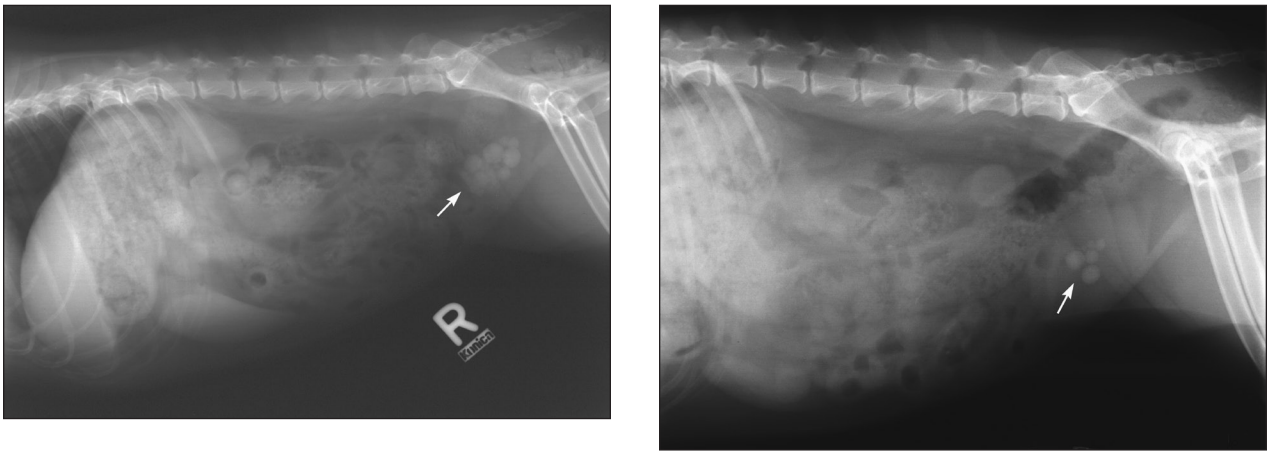

Figure 1A and 1B. Lateral abdominal radiograph (1A) depicting multiple radiodense bladder (arrow) uroliths in an 8-year-old female miniature schnauzer on day 1 of presentation. A lateral abdominal radiograph (1B) taken 40 d after initiating the feeding of a low fat, mildly protein-restricted, moderately acidifying dog food: fewer and less radiodense bladder uroliths (arrow) are observed. Case, with permission, from Grand River Veterinary Hospital, Caledonia, Ontario.

Due to owner constraints, the next recheck was performed 45 d later. Antibiotic therapy had been discontinued by the owner 15 d prior to evaluation. Clinically, the dog was apparently normal and the body weight was stable. Urine obtained by free-flow was evaluated microscopically only. Occasional red and white blood cells and bacteria were observed. No crystals were visualized. No abnormalities were detected on abdominal radiographs; there was no evidence of urinary calculi. Recommendations to the owner were to culture the urine, continue the current diet, and monitor for recurrent urinary tract infection.

Struvite urolithiasis in dogs is most often due to infection of the urinary tract with urease-producing bacteria (1,2). The bacteria (often *Staphylococcus* spp., *Proteus* spp.,) utilize urea in the urine to form ammonia and carbon dioxide. The ammonia is changed to ammonium, which, in turn, raises the urine pH and becomes available for the formation of magnesium ammonium phosphate crystals (struvite). As the urine pH increases, phosphate becomes more available to contribute to struvite crystal formation and struvite becomes less soluble. As the urine concentrations of phosphate, magnesium, and ammonium rise, supersaturation of the urine occurs, contributing to crystal and urolith formation (1,2).

A recent review of 16 000 submissions to the Canadian Veterinary Urolith Center revealed that female miniature schnauzers were as likely to have struvite urolithiasis as calcium oxalate urolithiasis (3). In the case presented here, the alkaline urine pH, the presence of struvite crystals, the infection with *Staphylococcus intermedius,* and the size of the uroliths observed radiographically (1 cm diameter) were most consistent with a diagnosis of infection-induced struvite urolithiasis (4). Calcium oxalate uroliths were less likely because they tend to form in a more acidic urine and are usually smaller in size. Although struvite crystals can form in vitro if urine is allowed to sit, or is refrigerated, prior to analysis, their presence was considered significant in this case, given the high urine pH and evidence of urinary tract infection (5).

Treatment of infection-induced or sterile struvite urolithiasis involves either surgery to remove the uroliths or medical therapy. Medical therapy of infection-induced struvite typically involves the use of a calculolytic diet (such as Hill's Prescription Diet s/d; Hill's Pet Nutrition, Topeka, Kansas, USA) and appropriate antimicrobial administration for 4 wk after apparent urolith dissolution (1,2). A typical calculolytic diet acidifies the urine (increases struvite solubility), has decreased substrate for urease-producing bacteria (low protein), and decreased levels of magnesium and phosphorus. Diuresis is enhanced by added sodium chloride and decreased protein levels in the diet. Ingestion of protein-restricted diets (of this magnitude) leads to low serum urea nitrogen levels and, subsequently, low renal medulla urea concentrations develop. This results in the production of dilute urine. In addition, decreasing the concentration of the urine also decreases the concentration of calculogenic substances. These diets have proven to be effective in both experimental and clinical studies. In a study of female beagles, a calculolytic diet (Hill's Prescription Diet s/d) was shown to be effective in dissolving infection-induced struvite stones in an average time of 14.4 wk (range 2 to 5 mo) (6). The same diet dissolved 100% of sterile struvite stones in an average time of 3.3 wk (range 2 to 4 wk) (6).

Because calculolytic diets are low in protein, they tend to be high in fat content (7). In breeds of dogs predisposed to pancreatitis or other fat-intolerant conditions, such diets may be contraindicated (1,2,7,8). Other contraindications for the use of a calculolytic diet that is high in sodium chloride include hypertensive disorders, such as those associated with renal or adrenal disease, or heart disease. Increased sodium levels may lead to volume expansion in patients with hypertension or cardiac disease and can exacerbate abnormal blood pressure or cardiogenic pulmonary edema. Lastly, because the diets are severely protein-restricted, they are recommended for short-term use only and in conjunction with strict monitoring of the serum biochemical profile and body condition in young and old animals (1,2,7,8). In

this case, a high-fat diet was not recommended because of the predisposition of miniature schnauzers to pancreatitis and hyperlipidemia (8,9).

There are several reports in the veterinary literature describing spontaneous dissolution of struvite nephroliths (10,11). In one case, dissolution occurred within 2 wk after ureteral patency was established (10). In another case, a urinary acidifier and sodium chloride were administered and dissolution occurred within 4 wk (11). In both cases, antibiotics were administered and diet therapy was not mentioned. In a study of dogs with struvite urolithiasis, dissolution occurred in 2 out of 6 dogs fed a maintenance diet with concurrent antibiotic therapy (1). Finally, sterile struvite uroliths dissolved over a mean of 14 wk (range 2 to 5 mo) in dogs fed a maintenance diet (6). These cases demonstrate that dissolution of struvite uroliths can occur within a short time without the use of a calculolytic diet, and may even occur with the use of a maintenance-type diet.

Appropriate antibiotic therapy is continued in cases of infection-induced struvite urolithiasis for 1 mo beyond the apparent dissolution of the stones on radiographs for several reasons. Although the surface of the stone and the urine may be sterile during dissolution, bacteria under the surface of the urolith may be protected from antimicrobial drugs, and may be released during stone dissolution (1,2). In some cases, bacteria may be adherent to the epithelium of the bladder, even though a urine culture appears sterile (12). In addition, antibiotics that destroy urea-producing bacteria will lower urine pH without the use of other acidifying agents by halting ammonium production. Finally, small uroliths (< 3 mm) may not be detected through routine radiographs or ultrasonography and may harbor bacteria (1,2). In this case, the owner stopped antibiotic therapy of her own accord, despite recommendations to continue treatment.

In the case described here, the dog may have passed 1 or more of the stones, since no stones were detected at the 45-day (6.5 wk) recheck. Radiographs taken at 30 d revealed a decrease in the number and diameter of the remaining stones, which may have reflected ongoing urolith dissolution.

Dissolution may have occurred due to antibiotic therapy, which decreased urine pH and increased struvite solubility. Another factor that may have contributed to stone dissolution is the decreased urea concentration in the urine induced by feeding a mildly protein restricted diet. Limitations of this case include incomplete urinalyses during the course of medical therapy, and a lack of follow-up. Recommendations are to monitor urine pH and specific gravity and to perform microscopic evaluation of urine sediment throughout the course of treatment. Urine should be cultured at the end of the treatment period to ensure that any urinary tract infection has been erradicated. In this case, the owner elected not to pursue follow-up diagnostic procedures.

In reporting this case, we offer an alternative treatment to a typical calculolytic diet for dogs that may be predisposed to fat-intolerant, cardiac, or hypertensive conditions, or where surgical removal of uroliths is not an option. If medical dissolution of stones is attempted, guidelines for proper follow-up should be outlined and strictly maintained to ensure a successful outcome. CVJ

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